GEOCHEMICAL STUDIES OF THE ENVIRONMENTALLY MOBILE METAL FRACTION IN BOX CORES FR0M THE MESSINIAKOS GULF (GREECE)

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Abstract

Eleven box core sediments collected from various sites of the Messiniakos gulf (SW Peloponnese, Greece) were analyzed for the determination of the environmentally mobile fraction of Mn, Cd, Cr, Cu, Ni, Pb, Zn, As. More significant inter-element correlation coefficients are presented. Enrichment factors were below 1 except of Pb (r_{ef} =2.6) and Mn (r_{ef} =1) at the central part of the gulf. Total enrichment values being much below 1 reveal a low degree of metal pollution.

Keywords: Metals, Pollution, Sediments

Messiniakos gulf is located in the SW Peloponnese (Greece). Its seabed is dominated by very abrupt inclinations with depths often higher than 1000 m, resulting in extensive landslips and sediment transport. Eleven box cores were collected from various sampling sites of the gulf and divided into two sections each, corresponding to 0-5 (top, T) and 20-25 (bottom, B) cm depth. All samples were subjected to acid dissolution using microwave heating with a suitable laboratory microwave unit, applying the method EPA3051 [1]. All digests produced were analyzed using ICP-MS for the determination of the fraction of metals Mn, Cd, Cr, Cu, Ni, Pb, Zn, As [2] considered as mobile in the environment. This method does not accomplish total decomposition of the samples and therefore a few refractory sample matrix compounds may not be dissolved. However, it was applied as it deals with the non-residual metal fraction that participates in most aqueous transport mechanism of pollution, and consequently it is a good indicator of the metal biological availability. Minimum, maximum and mean values for top and bottom sections are presented in Table 1.

Tab. 1. Min, Max and Mean values (μg/g) of the environmentally mobile metal fraction

		Mn	Cd	Cr	Cu	Ni	Pb	Zn	As
T	Min	189	0.7	21.8	4.5	15.4	4.4	7.6	5.8
T	Max	1518	3.0	77.8	43.4	81.7	48.3	74.6	24.6
T	Mean	564	2.3	53.8	25.1	50.7	17.1	48.5	12.9
B	Min	207	1.5	40.8	19.5	28.9	11.0	35.1	8.4
B	Max	3368	3.2	104.2	57.4	124.9	17.4	79.0	18.6
B	Mean	760	2.5	68.9	35.9	69.9	13.7	61.1	11.7

Studying the inter-element correlation coefficients at the two sets of data (top and bottom sections), it was found that there is strong correlation (>0.8) for the pairs (Cr,Ni), (Cd,Zn), (Cu,Zn), (Cu,Ni) (Cr,Cu), (Cd,Cu), (Cr,Zn), (Ni,Zn), (Pb,Mn) (Cd,Ni), (Cd,Cr). The same applies for (Cu,Pb) at the top section and (Mn,As) at the bottom one. In a following step, enrichment factors (r_{ef}) were calculated for the eleven top sediment samples by applying the formula

$$r_{ef} = (C_{sed} - C_{back})/C_{back}$$

where, C_{sed} is the content of a metal in each surface sediment sample and C_{back} is the mean content of the same metal for all bottom sediment samples [3]. The enrichment factors were below 1 except of Pb (ref =2.6) and Mn (r_{ef} =1) at the central part of the gulf. Lead is a good indicator of urban metal pollution and can be used for the estimation of the relative pollution in surface sediments. Total enrichment factor values R, defined as R=(Σ ref)/n, were much below 1, revealing a low degree of metal pollution.

References

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